

the form of the curve. When this plate is photographed, a series of dark lines, the intensity of which depends on the size and shape of the corresponding transparent areas, is produced. By superposing this photograph on the former one which gave the general distribution of light and shadow, a representation of the linear spectrum of the bolograph is obtained. Clearly, considerable skill and judgment are required in such a process, and the linear spectra are only introduced to show the general effect and to enable the reader to compare the infra-red with the visible spectrum; the measurements of the position of the lines are all made on the selected bolographs themselves.

Chapter vii. contains an interesting account of the variations of absorption in the infra-red spectrum, which is shown to be the seat of great terrestrial atmospheric absorption, the relative intensities of energy changing greatly at different periods of the year in some portions of the spectrum, while in others they remain fairly constant in amount.

But little space is left to refer to Part ii., subsidiary researches, which to a student of theoretical optics may prove even more interesting than the main research. The first of these deals with the dispersion of rock salt and fluorite. It is sufficient, perhaps, to say that the dispersion curve for rock salt is drawn from wave-length 0.5μ to 6.5μ , and the results compared with a formula—Ketteler's formula,

$$n^2 = a^2 + \frac{M_2}{\lambda^2 - \lambda_2^2} - \frac{M_1}{\lambda_1^2 - \lambda^2},$$

where

$$\begin{aligned} a^2 &= 5.174714 \\ M_2 &= 0.0183744 \\ \lambda_2^2 &= 0.015841 \\ M_1 &= 8949.520 \\ \lambda_1^2 &= 3145.695. \end{aligned}$$

This formula agrees admirably over the whole range.

Another appendix gives a full account of the construction of the galvanometer used for the research. In this instrument, various sizes of wire were used in the different sections of the coil; its resistance was 28 ohms, and the external radii of the three sections of which each coil is composed are respectively .383, .741 and 1.632 cm.

Two magnet systems were tried, the one being 2.4 mgs. in weight, the other 6.5 mgs. With the former, which proved too light for the work, a deflection of one millimetre at a distance of one metre was given by a current of 5×10^{-12} ampere; with the latter the current required was 23×10^{-12} ampere.

Enough, perhaps, has been written to indicate the interest and importance of the work. Prof. Langley is to be congratulated in having brought it to so successful a conclusion.

R. T. G.

SOUTH AMERICA.¹

IN the volume under notice, Mr. A. H. Keane gives a much needed compendium of the geography of South America. Since its independence from Spain and Portugal, that half-continent has been making great commercial strides, until its trade now equals in value that of British India. The importance of its varied products, its peculiar ethnological history, its wonderful physical features, its modern political advancement, make it a region of constantly increasing interest to the merchant, the man of science, the student and the statesman; while the fact that only about five-sevenths of it have thus far been explored and partially mapped makes it a favourite field for the geographer. Mr. Keane appears to have understood exactly what the world in

general required from his able pen, and instead of confining himself to geography pure and simple, as the title of his work indicates, he has taken his subject in its most comprehensive sense. He gives us, in three preliminary chapters, the physical features of the country, its orography, great plains, plateaux, fluvial systems, seaboard, fjords, outlying islands, climate, flora and fauna and a valuable dissertation upon the ethical and later ethnical and historical relations of its much scattered tribes. He holds it to be "beyond reasonable doubt that man had spread in early Pleistocene times from his eastern cradle to the New World, probably by two routes—from Europe by the still persisting land connection with Greenland and Labrador, and, from Asia, by the narrow Bering Strait." He bases this assertion upon the fossil remains of man which are found in North and South America, "representing the two primordial types, which may be called the long-headed Afro-European and the round-headed Asiatic. These, strange to say, are found in far greater abundance in the southern than in the northern division." . . . "The inference seems inevitable that South America was already in Pleistocene times peopled to its utmost limits by two primitive races that still persist in the same region"—a statement which admits of doubt. "The long-heads are believed to have been the first arrivals . . . and later the round-heads," the latter "generally keeping to the Pacific side." The former are supposed to have afterwards migrated from their early settlements in southern Brazil and Argentina over a greater part of eastern South America.

There is no more delightful and vexatious field for anthropological and ethnological research than South America. The physical alterations which it has undergone, even in very recent geological periods, the separation of its eastern from its western portion by immense inland seas, the vast denudation of the orographic system of the Brazilian and the recent uplifting of the Andean section, the formation of its wonderful rivers, all probably largely effected since the occupation of the continent by man, have woven many factors into the problem of racial development there. The few traces which forgotten peoples have left under extraordinary physical changes and climatic influences, and the fragmentary knowledge existing regarding South American tribes, make it appear venturesome to indicate the routes by which their progenitors first penetrated the southern half of the New World. The problem seems to require more study than it has yet received before its solution can be safely approached. But the somewhat extensive remarks of Mr. Keane upon South American ethnology are very valuable—doubly so from the fact that he not only summarises his views in his "General Survey," but elaborates them as he afterwards passes each country in review, thus making his work of great importance to the student of tribal origin and development on the western continent. Mr. Keane justly comments on the purity of race in the United States in comparison with Latin America, "where all the ethnical elements have, from the first, tended to be merged in a fresh division of mankind, which may eventually acquire a uniform character, but must long continue to betray its diverse origins in the heterogeneous nature of its physical and mental qualities." And yet it is not entirely improbable that in several of the Spanish American States, notably Mexico and Bolivia, the mentally and physically strong native race are reasserting themselves, and absorbing, thinning-down and gradually dissipating the blood of their conquerors.

The description of each State includes its boundaries, so far as they are claimed or defined, its physical features, hydrography, climate, flora, fauna, inhabitants, wild tribes, topography, chief towns, period of discovery, conquest, settlement, colonial rule, religion, education, natural resources, mineral and agricultural productions and a

¹ "Stanford's Compendium of Geography and Travel (new issue) Central and South America." Vol. i. By A. H. Keane. Edited by Sir Clements Markham, K.C.B., F.R.S. Pp. xxii + 611. (London: E. Stanford.) Price 15s.

historical outline, thus giving us, *à grandes rasgos*, the data sought by any one who desires, in a limited space, to acquire a general knowledge of the country.

Regarding Venezuela, "it is still mainly inhabited by scattered rural communities and nomad tribes, with scarcely any large industrial or commercial centres." As to the Orinoco River system, "these magnificent inland waters are at present utilised in a regular way only by a single steamer, plying once a fortnight between Trinidad and Ciudad Bolívar," which is the only town of any importance on the Orinoco. To this river Mr. Keane gives a fall of about nine inches to the mile in a distance of 1300 miles, counting from the Cassiquiare Canal, that remarkable connecting link between the waters of the Orinoco and the Amazon. It is doubtful if the average slope is more than three inches to the mile, the mistake arising from the elevation of 920 feet above sea-level, which Mr. Keane assigns to the Cassiquiare, which probably does not exceed 335 feet elevation. This is one of the most important elevations in the interior of South America,

country belongs to a few absentee owners, whose estates are often of boundless extent." He is right in part, but the religious institutions should have been included among the proprietors of the country *and its people*. It would also have been well to add that the interior of Ecuador, since the Spanish conquest, has had contact with the outer world by only two mule-tracks, both intransitable during the rainy season, and that, behind the coast cordillera, the priest has, for more than three centuries, had undisturbed opportunity to try his theories of progress. The result has been disastrous to the morals and advancement of the people, who are sunk in intellectual and physical degradation.

Peru, Bolivia, Chile, the Argentine Republic, Paraguay and Uruguay are treated according to their relative importance; but sometimes the reader craves greater detail upon many interesting points, probably unwillingly withheld and retained in the abundant stores of information apparently in possession of the author.

In general, the maps which accompany the work are



Lake Nahuel-huapi, in the Andes of north-western Patagonia.

and, since remote times, it has largely governed its hydrographic conditions. There is no part of the world where there is greater confusion in altitudes and distances, and the writer on the geographical features of South America often finds his patience sadly taxed by the disagreement between travellers and explorers regarding measurements.

The States of Colombia and Ecuador form interesting chapters of the work under consideration. The former, which is just terminating a most bloody and disastrous politico-religious war, aggravated by the influx of a swarm of Philippine friars, is a land where nature seems to have overlooked no favours within her power to bestow, and Mr. Keane pictures them with graphic pen. As to Ecuador, the most dormant of all the South American States, he says:—"The backward state of the agricultural interests is no doubt partly due to the constant political ferment which drives off capital, but also in great measure to the feudal system of land tenure. The whole

unworthy of the text; old geographical errors are reproduced, and the maps are in no sense up to date, except those of Chile and the Argentine Republic, *which are more than up to date*; for the question of limits between these countries, which is now under arbitration by the English Government, is apparently decided entirely in favour of Chile, although upon what grounds does not appear, as Mr. Keane and the editor, Sir Clements Markham, have wisely avoided any expression of opinion on the subject. One must therefore attribute to the publisher the glaring inconsistencies between *his* maps and the text of the work, it being evident that the author is not responsible for them. The boundary, as laid down between Chile and Argentina, is only of value in one sense—it shows the extent to which Chile hopes the English umpires will allow her to push her claims. The line could not have been better traced by the Chilean Foreign Office. To Chile alone it is useful; but the public expect that a map publisher of

repute will hold an even balance where boundaries are *sub judice*.

In the case of the Chile-Bolivia boundary, it appears that the publisher also considers that Bolivia has no territorial rights which Chile is bound to respect.

Mr. Keane closes his work with an extensive and valuable chapter on Brazil, a country which occupies nearly one-half of the area of South America. His remarks upon the "ethnic elements of the population and their distribution" he considers of value in estimating the probable political future of the Republic. "The triple fusion of aborigines, negroes and Europeans is mainly confined to the Atlantic States between the Amazon estuary and Rio de Janeiro. Then follow the States of San Paulo, Paraná, Santa Catharina and Rio Grande do Sul, with which must be grouped the vast and relatively populous region of Minas Geraes. Here we have no triple fusion, the negro element being everywhere mainly absent; but, as in Spanish America, an amalgam of aborigines and whites . . . which constitute the second section of the Brazilian people, distinguished from the first by the absence of black blood. Lastly, the aboriginal element tends to disappear in the direction of the south, where the white element is continually strengthened by direct accessions from various parts of Europe, but especially Italy, Portugal and Austria."

As to the above quotation, the State of Minas Geraes is the most populous in Brazil, and the negro element is everywhere in evidence; and instead of an "amalgam of aborigines and whites," few of the inhabitants are free from negro blood. Exclusive of the aboriginal tribes, one seldom finds any traces of Indian blood among the Brazilians except in the immediate vicinity of the banks of the main River Amazon.

Notwithstanding a few details where we might disagree with Mr. Keane, he has given us a most useful work of reference; but every reader at all familiar with South American geography will regret that the maps are not more trustworthy. GEORGE EARL CHURCH.

ZONES IN THE CHALK.

ATTENTION was directed in NATURE for April 26, 1900, to Dr. A. W. Rowe's researches on the zones of the White Chalk of Kent and Sussex. Dr. Rowe has since published his observations on the White Chalk of Dorset (*Proc. Geol. Assoc.*, vol. xvii. part i. 1901). Aided in the field as before by Mr. C. Davies Sherborn, the author has made a particular study of the higher portions of the Chalk which commence with the zone of *Rhynchonella Cuvieri*.

Those who are familiar with this portion of the Dorset coast, or have read Mr. Aubrey Strahan's explanatory memoir (published by the Geological Survey), know how faulted and crushed are the strata in many places, and how difficult or impossible of access are many portions of the cliffs. Undaunted, however, by these obstacles, or by the hardness of the Chalk and the trouble in extracting and preserving the often shattered fossils, Dr. Rowe and Mr. Sherborn "have been able to fix, with varying degrees of accuracy, the limits of nearly every zone," and to record from each a characteristic fauna. While confirming the general conclusions of Dr. Barrois, they have amplified our knowledge to a remarkable extent, and have had the satisfaction of determining the presence, hitherto unsuspected in the region between White Nothe and Studland Bay, of the higher Chalk zones of *Actinocamax quadratus* and *Belemnitella mucronata*.

That zones in the Chalk are purely zoological divisions is thoroughly borne out in this paper, and although it is remarked that "nothing but rigid collecting gives one the faintest chance of obtaining the junction between the various beds," it is evident that no more definite

boundary is to be expected between zones than that which in human chronology separates one century from another. Here and there particular flint-bands, the nodular character or the colouring of the Chalk afford local guides for marking approximate junctions or for tracing horizons from place to place amid the complex disturbances of the strata; and these have been carefully noted. Dr. Rowe, indeed, felt some "anxiety to find a lithological feature" whereby to permanently mark the planes of division he took, but this was seldom possible, nor could it reasonably be expected in such a comparatively uniform series of strata. Nevertheless, the results of Dr. Rowe's painstaking work have been in many instances permanently recorded in a series of beautifully executed plates prepared from photographs taken by Prof. H. E. Armstrong. Diagrams accompany these plates to show the positions of the several zones and the limits assigned to them. No higher testimony to the value of zones has, perhaps, ever been given in this country, for the authors have had a veritable geological puzzle to deal with, and they have interpreted it by means of their long experience of Chalk fossils and by assiduous collecting. By these means the knowledge elsewhere gained where the sequence is unbroken has been applied with marked success, and the progressive changes in the life-history of the Chalk have been found to correspond with a precision that could not have been expected in strata deposited under more varying conditions. While the zones are marked out within narrow limits by certain dominant species, yet where these zonal forms are absent the "zones are often as accurately defined by their associated guide-fossils." These are noted with reference to Dorset.

It may be observed that, with the exception of *Marsupites*, *Actinocamax quadratus* and *Belemnitella mucronata*, the dominant forms are not confined to the zones they characterise. The author makes some remarks on the varying position of the layers described as Chalk Rock. No doubt any type of rock may be found at any horizon, but it must be remembered that the limits assigned to Chalk zones are approximate. There is nowhere any real boundary, and even some dominant types may have existed in abundance longer in some areas than in others. H. B. W.

THE ORIGIN AND HABITS OF THE BACTRIAN CAMEL.

OF few of our larger domesticated animals is the origin so buried in mystery as is that of the camels. Till a few years ago, indeed, naturalists were in doubt whether the two-humped Bactrian species was really a native of the countries where it is now kept in a domesticated condition. The probability was, however, all in favour of such being the case; and the recent discovery of remains of fossil camels in several parts of Europe, as well as the occurrence of such remains in Asia, afford strong corroborative evidence that eastern Europe and northern Asia formed the original habitat of the wild Bactrian species.

The subject has recently been discussed in *Globus* for May 2, 1901, by Dr. A. Nehring, of Berlin, who expresses himself in favour of the view that some, at least, of the two-humped camels which roam at liberty over the wastes of the Gobi are indigenously wild animals.

Years ago the occurrence of remains of fossil camels (*Camelus sivalensis*) was recorded by Falconer and Cautley in the Tertiary strata of the Siwalik Hills of northern India. The dentition of this species is numerically the same as in the two living members of the group; and from this circumstance, coupled with the well-known affinity between the extinct fauna of the Siwaliks and that of Africa at the present day, it is not improbable